Hoping to Teach Someday? Inquire Within:
Examining Inquiry-Based Learning
with First-Semester Undergrads

Erik Jon Byker
University of North Carolina at Charlotte

Heather Coffey
University of North Carolina at Charlotte

Susan Harden
University of North Carolina at Charlotte

Amy Good
University of North Carolina at Charlotte

Tina L. Heafner
University of North Carolina at Charlotte

Katie E. Brown
National Center for Montessori in the Public Sector

Debra Holzberg
University of North Carolina at Charlotte

Using case study method, this study examines the impact of an inquiry-based learning program among a cohort of first-semester undergraduates (n=104) at a large public university in the southeastern United States who are aspiring to become teachers. The Boyer Commission (1999) asserted that inquiry-based learning should be the foundation of higher education curricula. Even though inquiry pedagogies are emphasized in teacher education, many prospective teacher candidates have limited experience with inquiry as a constructivist practice from their K-12 settings. This study investigates the effects and first-semester undergraduates' perceptions of an inquiry-based learning project. The research is grounded in Knowledge Building Theory (Scardamalia & Bereiter, 2006), which posits that knowledge building is comprised of three components: 1) inquiry driven questions, 2) epistemic artifacts, and 3) collective spaces for collaboration. The study found that inquiry projects had positive effects on participants' understanding of: the complexity of educational issues; the overall inquiry process; and a future career in teaching. Using Knowledge Building Theory, the findings are discussed and analyzed to posit a conceptual model of the entire inquiry process, called the Inquiry Processing Cycle. Keywords: curiosity, first-year students, Inquiry Processing Cycle, Knowledge Building Theory, teacher preparation

Introduction

Higher education has put heightened emphasis on delivering high impact practices like undergraduate research experiences even in the first-year of study (Kuh, 2008). While college-career ready (CCR) standards are designed to prepare students academically, many first-year students are unprepared for the challenges of research in postsecondary education (Achieve, 2013). In particular, many first-year students find that it is a challenging transition towards the independent thinking necessary for systematic research and conclusion drawing. To support these students, universities are adopting pedagogies—like inquiry-based learning—that immerse students in higher-order thinking and communication activities. Inquiry-based learning (IBL) is a student centered instructional method that fosters the development of logical thinking and coherent writing. IBL is about the rigorous construction of knowledge and ideas rather than just the passive transmission of knowledge that is typified by traditional lecture pedagogy. The purpose of this article is to describe and report on a case study of a university-wide, first-year student IBL initiative. Specifically, we examine the perceptions and practices surrounding IBL among a cohort of 104 first-year students (n=104) who are all aspiring to become future teachers. The article is organized in five sections. First, we provide context for this study by describing background information and situating the study in a theoretical framework regarding IBL. Second, we review the literature to identify prior studies about IBL in higher education. Third, we report on the method for conducting the research. Fourth, we share the study's findings. Last, we discuss the research implications and recommendations for future research.

Context

Two decades ago, the Carnegie Foundation for the Advancement of Teaching convened a commission to develop guidelines for improving undergraduate education at research universities. The Boyer Commission (1999), as the commission came to be known, issued a report featuring ten recommendations for research universities to transform their baccalaureate programs for the 21st century emphasizing the importance of inquiry. The first two of these recommendations deal explicitly with inquiry and include making research-based learning the standard throughout the undergraduate program and constructing the freshmen year curriculum using inquiry-based pedagogies. Using a social justice metaphor, the Boyer Commission (1999) also asserted that a university student's "Academic Bill of Rights" (p. 12) rests on four pillars:

(1) inquiry-based learning; (2) the development of coherent and reasoned communication; (3) the appreciation of the arts, humanities, and sciences; and (4) a comprehensive preparation for the future. The commission held that when these rights are instituted, the outcomes are university students who are equipped to be clear thinkers and problem solvers, students who will be leaders in their respective fields and careers (Boyer Commission, 1999). By listing inquiry as the first of four rights, the commission clearly prioritized inquiry as essential to undergraduate success and positioned inquiry pedagogies as an instrument of educational justice, in contrast to the lecture-based approach which proliferates.

Background

Since the Boyer Commission's report, research universities have revised programs to include inquiry pedagogies. Some universities have begun to pilot an IBL model as part of first-year orientation courses, which is often a requirement for all incoming freshmen students. This article examines one such IBL pilot program, referred by the pseudonym "Prepared for Success," that a large public research university in the southeastern United States adopted in the fall of 2012. The Prepared for Success (PFS) program is part of the university's vision to enhance the quality of education and to increase engagement with first year college students. The PFS purpose is centered on three major student learning outcomes: 1) commitment to success, 2) an understanding of learning and inquiry, and 3) intercultural awareness.

The PFS program addresses the aforementioned student learning outcomes with three central goals for first-year students. The first goal, *Intentionality*, helps students identify and create meaningful goals and then supports students in developing strategies to achieve their goals. The second goal, *Curiosity*, is predicated on the idea that asking meaningful questions is the first step in the inquiry process and students who actively participate in their educational experience by being curious will be more invested as the inquiry process deepens throughout their college experience. The third goal is *Awareness*. Students who are aware understand how preconceived notions, culture, and experience contribute to their sense of self and others.

This study focuses on the curiosity goal. To tap into curiosity, students in the PFS courses engage in a semester-long inquiry project that has the following goals: 1) develop and refine a research question; 2) locate and analyze resources; and 3) draw conclusions, insights and ideas. In the initial phase of the project, the PFS students choose their inquiry topic. They then develop

a research question and outline a research plan for answering their question. To facilitate the completion of these inquiry projects, multiple support systems are in place. For example, university librarians host "how-to" workshops for PFS students demonstrating the ways to locate, identify, and select salient, peer-reviewed literature. PFS students are also provided with information about resources such as the Writing Center at the university. Concurrently, professors, graduate assistants, and undergraduate teaching assistants work with PFS students in formulating their research questions. The PFS students' curiosities are further piqued with opportunities to attend distinguished speaker sessions, career fairs, and program orientations. At semester's end, the PFS students present their inquiry projects in written and verbal formats.

Theoretical Framework

Marlene Scardamalia and Carl Bereiter's (2006) Knowledge Building Theory provides the theoretical underpinning for our study. Knowledge Building Theory is situated in the constructivist belief that people create meaning from their learning tasks and activities (Bereiter, 2002). The PFS inquiry project reflects the process of knowledge building in a number of ways. For instance, the inquiry project is designed to tap into students' curiosity, and students develop lifelong learning skills related to research and drawing conclusions. Another example is how the inquiry project reframes the learner-instructor relationship as a partnership of knowledge construction. Scardamalia and Bereiter (2006) developed Knowledge Building Theory from their research on how young learners construct meaning and build knowledge in the school classroom. The theory goes beyond just the transmission of information to investigating the process by how knowledge is constructed and created (Bereiter, 2002; Paavola & Hakkarainen, 2005). Knowledge Building Theory offers a lens to the process of inquiry and has three features that we highlight as a framework for this current study.

First, knowledge building is grounded in inquiry-type questions about problems or issues. The inquiry-type questions should be challenging and push a learner's existing knowledge. Questions should also be authentic. Knowledge building is authentic when it is about actual knowledge construction rather than the busy work of knowledge facsimile. Scardamalia and Bereiter (2006) explain the importance of authenticity when it comes to the knowledge-building question, "When knowledge building fails, it is usually because of a failure to deal with problems and questions that are authentic for students and that elicit real ideas from them" (p.

117). Second, knowledge building is supported by artifact creation. Knowledge building is an intentional act when learners see themselves as fully part of the knowledge creation process. Artifacts provide the evidence for further advancing existing knowledge. The artifacts should reflect an intentional process for design and creation that involves the learner from the start. A knowledge building artifact should have an epistemic quality whereby the artifact poses additional questions for the creation of further knowledge (Scardamalia & Bereiter, 2006). Consequently, epistemic artifacts—according to Knowledge Building Theory—have a multiplier effect and accelerate the pace of knowledge creation. Third, knowledge building includes community. There is collective quality to knowledge building and the understanding that knowledge is a public good for the community to share. Knowledge building is supported through an intentional learning community that focuses on extending the limits of existing knowledge through a discourse.

In sum, the study is grounded in three main features of Knowledge Building Theory. The premise is that knowledge building includes: 1) inquiry driven questions, 2) epistemic artifacts, and 3) a community. Using this framework, in the remainder of this article we further probe the ways that the study's participants constructed knowledge as part of their inquiry projects. We also revisit Knowledge Building Theory to analyze and discuss the study's findings in relationship to this theoretical frame.

Literature Review

There is greater emphasis on inquiry since the Boyer Commission (1999) called for a move away from traditional lecture-based instruction towards a shared "adventure of discovery" (p. 16). Research has demonstrated that students who use inquiry driven approaches to problem solving achieve higher grades and experience greater overall success at the university (Hugerat & Kortam, 2014; Laursen, Hassi, Kogan, & Weston, 2014). For example, Sandra Laursen and her colleagues (2014) conducted a four year quantitative study of over 100 course sections of mathematics classes at four research universities. They compared a sample of sections that used IBL practices compared to a sample of sections that were lectured-based. They found that the students in the IBL classes had better grades and higher retention in mathematics courses compared to the control group.

Inquiry Improves Outcomes

Studies have shown IBL can improve student learning outcomes including academic performance, critical thinking, and motivation. Justice, Rice, and Warry (2007) compared the academic performance of Canadian university students who took an inquiry course in their first semester to that of comparable students who did not take the inquiry course. Age, gender, SES, high school GPA, and high school English achievement were controlled. Taking the inquiry course was associated with significant differences in academic performance; students who took the inquiry course were less likely to drop out and more likely to achieve honors standing than students who did not take the course. Hugerat and Kortam (2014) found that introducing inquiry methods in a freshman science class significantly improved students' higher-order thinking skills. For example, IBL can have a tremendous impact on critical thinking (Ahuna, Tinnesz, & VanZile-Tamsen, 2011; Gupta, Burke, Mehta, & Greenbowe, 2014). In the Gupta et al. (2014) study, first-year chemistry students receiving inquiry-based instruction significantly outperformed the control group on measures of critical thinking and actually outscored a group of fourth-year chemistry students who had also received traditional instruction. Work by Trigwell, Prosser, and Waterhouse (1999) suggests that IBL can improve students' motivation and effort; these authors found that when instructors took a more student-centered approach to learning, like inquiry, students were more likely to report a deep approach to learning rather than a surface-level or perfunctory approach.

Inquiry Practices

The literature examines specific practices--like technology integration, collaborative learning, and experiential learning-- that postsecondary educators use to support inquiry in their courses. One emphasis is on using multimodal tools—like PowerPoint—to conduct and present inquiry related projects (Ellis, 2014; Lawrie et al., 2014). Simulations and primary source images are examples of multimodal strategies that can support inquiries into general research topics (Bailey & Van Harken, 2014) and cultural diversity (Inglis, et al., 2004). Collaboration can also support inquiry. Collaboration has been found to aid in the development of learners' metacognition, self-regulation, agency, social awareness, dialogue, and comfort with ambiguity (Muukkonen & Lakkala, 2009). Collaboration can also take the form of a research apprenticeship where a student engages in an inquiry project with a university professor.

Participation in research apprenticeships is linked to greater clarity in career aspirations, a refined understanding of inquiry, increased content knowledge, increased confidence and self-efficacy, intellectual development, and high levels of satisfaction with the apprenticeship experience (Cook & Buck, 2014; Sadler, Burgin, McKinney, & Ponjuan, 2009).

Teacher Education and Inquiry

Much of the literature on inquiry at the university is confined to field of math and science. There are a limited number of studies in the field of teacher education. Although, teacher education scholars have called for a closer marriage between research and teaching in higher education (Brew, 2012; Nelsen, 2015), gaps in the literature exist regarding inquiry-based curricula for teacher education especially in foundational courses early in programs. Inquiry is an essential skill for students in teacher preparation because curiosity and the willingness to engage in constructivist learning are important predispositions for successful teachers (Brew, 2012). Peter Nelsen (2015) argues that inquiry should be infused into every aspect of teacher education to produce teachers who are in the habit of questioning and thinking critically.

There is some scholarship that has specifically examined the use of inquiry in teacher preparation. Troy Sadler and his colleagues (2009) found that practicing and preservice teachers who engage in inquiry opportunities exhibit a greater desire for and comfort with collaboration as well as increased use of research- and inquiry-based classroom practices. Teacher candidates who participated in IBL also have been found: (1) to identify as scientific researcher (Cook & Buck, 2014); (2) improve in their creativity and scientific processing skills (Yakar & Baykara, 2014); and (3) enhance their observational skills and data analysis (Bailey & Van Harken, 2014).

Research Questions

As stated earlier, much of the research on inquiry-based learning in higher education focuses on science and mathematics courses. There is a gap in the literature related to IBL practices in teacher education, specifically with first-year undergraduate students who have a desire to be future teachers. Indeed, there is a dearth of information on utilizing inquiry-based learning practices in introductory teacher preparation courses. To address the gaps in the literature and to provide new understanding about inquiry-based learning in teacher preparation programs, our study had three research questions:

1. What types of inquiry projects do first year students, who are enrolled in the Prepared for Success course, develop?
2. What are the effects of inquiry-based learning on first year students' conceptions of inquiry?
3. How do first year students perceive the relationship between inquiry-based learning and their future teaching practice?

Method

Our study employs case study method. According to Robert Yin (2008), case study is a research design for empirical inquiry that allows for the investigation of complex phenomena using single or multiple cases of the phenomena. The study's sample is comprised of 104 participants (n=104). All the participants were first-year, first-semester undergraduate students who were aspiring to be future teachers. About 81% of the participants identified as female and 19% identified as male. Among the participants, 67% were White females, 8% were Black females, 5% were Asian females, 1% was Latina, 10% were White males, 2% were Black males, 5% were Asian males, and 2% of the participants selected their racial demographic as Other.

Setting

The university's College of Education offered three PFS sections in which the participants were enrolled. One section was presented in a co-teaching model, the other two sections were taught by individual instructors. All three sections had a graduate assistant supporting the PFS course. Two sections, the sections not co-taught, had undergraduate teaching assistants. The PFS course instructors planned with each other and had similar course syllabi. All the PFS sections had the same assignment requirements.

Data Collection

To further investigate the study's research questions, the research team collected three sources of data: artifacts, field observations, and focus group interviews. Student artifacts were collected from all three sections. The collected artifacts included the participants' inquiry projects and their reflection statements about their inquiry projects. The course instructors' field

observations were another source of data. The field observations captured the instructors' perceptions of the PFS participants' participation and understanding of the inquiry projects. The field observations were also helpful in contextualizing the study within the field of teacher education. Focus group interviews were the third source of data. Research assistants conducted the focus group interviews so as allow for greater objectivity for the participants to share their response to the interview questions (See Appendix). The focus group interviews took place after the inquiry projects were completed with a random sample of three participants from each section, there were nine participants in total for the focus group interviews. The students selected for the focus groups were chosen using a random number generator. It was a stratified random selection of students to control for gender and race. The research team originally planned for focus groups of five students per section, but not all the randomly selected students could attend because of the end of semester timing of the focus group interviews. Given the time constraints, the research team proceeded with three randomly selected students from each section.

Data Analysis

The study's artifacts and field observations were examined using Miles and Huberman's (1994) three-step interpretive approach and Glaser and Strauss (1967) constant-comparative method. First, the data were read several times and then coded as part of data reduction. Frequencies in the data were identified and analyzed to establish patterns, which were further categorized. Second, the data were displayed with charts and figures to compare, contrast, and probe for additional categories across the artifacts and field observations. Third, conclusions were drawn as the categories were organized into themes. The study's focus group interviews were also examined using the constant-comparative method, which was employed independently by each member of the seven-person research team. Interview data were transcribed and analyzed using an inductive coding process (Charmaz, 2006), whereby research team members coded interview transcripts individually for emergent themes and then compared codes with a partner. Following the methodological guidelines for generating inter-rater reliability of coding through random sample (Hruschka, Schwartz, St. John, Picone-Decaro, Jenkins, & Carey, 2004; Miles & Huberman, 1994), the inter-rater reliability of data coding was assessed among the research team using a random selection of 25% of transcriptions. The inter-rater reliability was found to be over 90% agreement in coding. The research team discussed and resolved any coding

disagreements by creating separate codes or combining the codes into larger categories. These categories were then shared across the research team and combined into themes.

Findings

A number of findings emerged from the study. We report the findings by re-examining each of the study's research questions. First, we share findings about the inquiry project topics and formats the participants developed. Second, we describe the participants' conceptions of the effects on inquiry based learning. Third, we address the perceptions that the participants had about the relationship between inquiry-based learning and their future role in education.

Inquiry Projects

Through the inquiry project, we hoped to engage students in the identification and research around a topic in the field of education. Ideally, through the coursework, students would identify a topic of interest or of concern and then develop and refine this question. By creating an annotated bibliography of scholarly articles about their question in order to organize information and present the findings of their research to the class, students would engage in a community of inquiry. Students were encouraged to choose a presentation format that demonstrated their talents and abilities and to be creative in communicating their findings.

There were multiple topics that the participants selected for research. Topics ranged from addressing the "Achievement Gap" to issues in Science, Technology, Engineering, and Math (STEM) education. In reporting these topic choices, we categorized the topics into larger themes. For example, Autism spectrum, inclusion, intellectual disability, learning disability, and special education were all topics that the participants selected. We combined these topics into one large category labeled Special Education. The category labeled Assessment, as another example, included topics like Common Core, report cards, and standardized testing. Table 1 shows the participants' topic choices and the percentage distribution of topic categories.

Table 1: Participants' Inquiry Project Categorized Topic Choices and Percentage Distribution

Project Categories	Percentage
Academic success	9%
Assessment	9%
Equality	6%
Instruction	12%
Parental role in education	21%
Poverty	14%
School funding	9%
Special education	16%
STEM	4%

As Table 1 depicts, the category related to the parental role in schooling and education was the most popular topic category among the participants. Some of the specific topics that were combined to develop this category include: divorced parents, incarcerated parent(s), the parents' role in supporting literacy, and parent-teacher conferences. Over 1 in 5 participants selected a topic related to parental roles in education and schooling. Special education was another popular topic category with over 16% percent of the participants. Almost 12% of participants selected a topic that could be categorized with the label of instruction. The specific topics under this label included differentiation, multiple intelligences, and world languages. The participants were able to select how they wanted to present their topics and inquiry projects. The course professors provided several format presentation options such as creating a website, developing a documentary, making a research poster presentation, or writing a traditional research paper. Figure 1 shows a pie chart with the percentage of inquiry project formats selected by the participants.
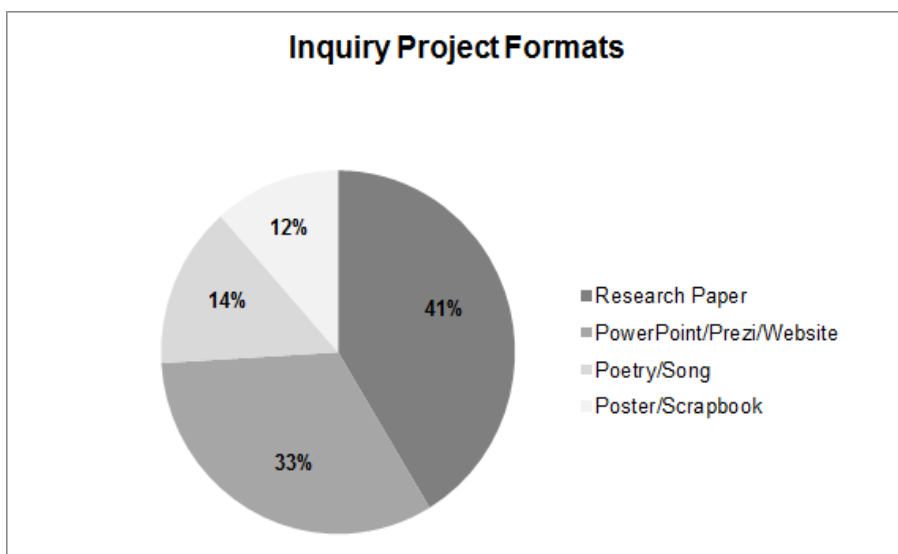
Figure 1. The formats that participants used to present their inquiry projects.

As Figure 1 shows, 41% of the participants chose the traditional research paper format for the presentation of their research topic. A little more than 33% of the participants selected an interactive presentation using software like PowerPoint, Prezi, or Weebly - a website creator. Taken together, almost three out of every four participants selected either the traditional research paper or an interactive presentation as their inquiry project's presentation format. Curiously, participants were encouraged to propose their own format for presenting their research, but none of the participants selected this option.

Effects of Inquiry-Based Learning

The second research question was about the participants' conceptions of the effects of inquiry-based learning. In their focus group interviews, many participants spoke positively about the effects of their projects. The effects can be summarized in two specific findings. First, the participants found their inquiry projects meaningful. Second, the participants gained a deeper appreciation for the inquiry process.

Meaningful. In their reflections on their inquiry projects, many of the participants identified that inquiry-based learning was meaningful. The meaningfulness was communicated in specific ways. One way was relevance to their learning. Participants shared how they were able to apply the inquiry-based learning practices to courses that they were taking during the semester. One

participant, for instance, shared how, "The inquiry project was a big hands-on learning experience that provides a certain foundation for the whole college experience." This participant went on to further explain how the inquiry project was applicable in many different ways to being an informed and successful student. Another participant identified the relevance of the inquiry project by simply stating, "It sets you up for the rest of your time going through the education major." Other participants concurred with this sentiment and shared that there are many ways to apply the research skills they learned as part of inquiry-based learning. One participant summed up the relevance of the inquiry project by sharing how inquiry was connected to all her other course work.

Choice was another attribute of the inquiry project that was meaningful for the participants. Many of the participants shared how they appreciated being able to choose their topic for their inquiry projects. One of the focus group interview prompts questioned participants about what aspects of the course were the most meaningful. One student responded, "I thought the inquiry project was meaningful because you could choose your topic. The inquiry project allowed me to focus on special education which is what I'm going to do. I got more out of the project because of it." Another participant explained that, "For the inquiry project, everybody chose their own topic. We were supposed to pick something that was meaningful to us." From the participants' perspectives, having choice about their topic selection increased the meaningfulness of their inquiry project through self-directed learning.

Inquiry Process. Another effect of inquiry-based learning was that participants gained a deeper appreciation for the process of inquiry. The participants identified the inquiry process as involving several components, including the development of research habits like going to the library, searching databases to find resources, writing, and presenting research conclusions. Indeed, many participants spoke about this process of inquiry, which they gained from their inquiry projects. The inquiry process habits were addressed in the participants' responses about their inquiry projects. Figure 2 provides a graphic of the participants' perception of what the inquiry process included. The figure includes broken lines and arrows. The broken lines are indicators for the lack of sequential connection in the participants' responses related to the skills they identified. For example, the participants did not refer to the inquiry process as a list of sequenced skills. Rather, they discussed each skill separately, but in the context of a larger

inquiry process. The arrows on the figure represent how the course professors discussed the inquiry process sequence in the assignment description and in other inquiry-based learning documents. Participants did refer to the collaborative aspect of writing and presenting so there is a curved line that reflects their perceptions this way.
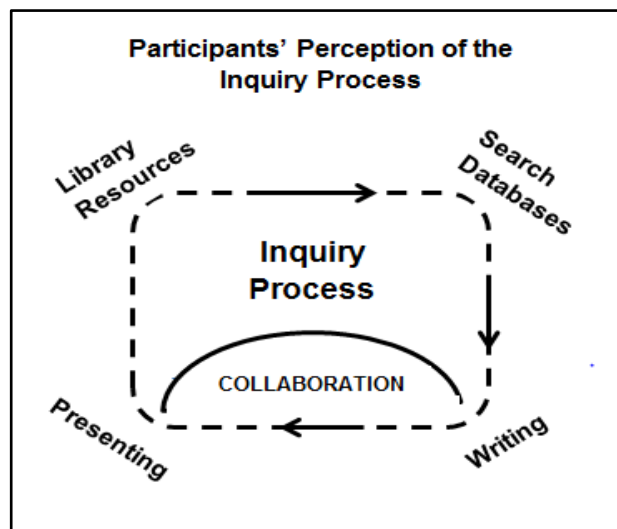

Figure 2. The participants' perception of the inquiry process.

Library Resources. As Figure 2 shows, the participants identified accessing the library resources as the first part of the inquiry process. For example, one participant identified the importance of going to the library in response to the interview question about the most meaningful aspect of the course. The participant explained, "We talked a lot about the research process. Going to the library has helped me in my other classes. When we did the library research databases, I've used that three or four times in other classes already." When asked what they learned about what it takes to be successful in the university, a participant replied, "I would have to say the library research is most important. That's my number one thing that I think will allow me to be successful in college." For the participants, an effect of the inquiry project was becoming familiar with the resources at the library. Furthermore, the participants recognized that starting research at the library is a key facet of the inquiry process.

Search Databases. Another inquiry process that participants mentioned was becoming familiar with how to search and access reference databases for scholarly purposes. The participants found

the skill of conducting searches using databases to have a high degree of relevance for their lives as undergraduate students. One participant, for instance, shared how she taught a group of friends how to use databases for locating articles and conducting research. She further explained that, "Research databases are available through the library. I showed [my friends] which one I used in this class. I showed them how to do a regular search, an advanced search, or how to trim their search with specific keywords." Learning how to search databases was another part of the inquiry process and effect of the inquiry-based learning.

Writing and Collaboration. Participants also identified collaboration as being part of the inquiry process and discussed collaboration in two specific ways. One way was about collaboration in relationship to writing their inquiry project. The second way was related to collaboration and the actual presentation for their inquiry projects. For many of the participants, the actual writing part of the inquiry process was challenging. When referring to the word "writing" in their focus group interviews, the participants used descriptors like: hard, hate, procrastination, tedious, and time management. The participants, though, identified collaboration as beneficial to their writing. A couple of participants described a classroom activity that was especially helpful in organizing and planning their writing for the inquiry project. The activity, the participants explained, "was like a seminar" where the class was divided into small groups and people shared a draft of their research topic proposal. Students also provided updates about their writing for the project. One participant pointed out the value of this activity as a hopeful endeavor:

> I never thought to ask someone else to help me with writing. I just thought, I'm
> hopeless and it's going to be bad. But everybody was like, you put note card after
> note card, after note card. I could see physically how my paper could grow and
> how I could get better at organizing my thoughts. That allowed me to see that I
> could be better at writing through that thought process. Working with other
> people helps me grow and understand how to do things better.

This same participant also shared another positive benefit of the collaborative aspect of sharing writing, "This activity stood out because I am a terrible writer. I hate writing, but when people put ideas in my mind for writing my project they weren't saying my writing was bad rather they were saying how I can grow from this." Another participant shared similar thoughts about sharing the writing in a group, "It wasn't like people were biting on your writing project; it was a

peer review thing. I'm doing a writing class now because of this experience. It helps to see what kind of ideas everyone has toward your paper." These quotes reflect how the participants believed that sharing their writing in a group was a growth experience and a positive effect of the inquiry process.

Presenting and Collaboration. Collaborating through sharing and presenting their actual inquiry project presentations was the final part of the inquiry process that the participants recognized. One participant explained how collaboration through the presentation of inquiry projects was beneficial, "We had to find facts to back up everything. I felt that helped us gain a better understanding of our topics and we weren't just spitting out words." Another participant shared about the effect of the collaboration and presentation of the inquiry projects, "I've known about some topics covered in the inquiry projects, but I gained new understandings instead of basic knowledge. For example, from a peer's inquiry project on inclusion, I've learned that there is more to see than the eye shows." The presentation component of the inquiry project was a beneficial effect of the inquiry process. As the participants asserted in the quotes above, the collaborative nature of presentation helped the participants to deeply understand education related topics and issues.

Future Role in Education

The third research question inquired about what connections, if any, the participants made between inquiry-based learning and their future teaching practice. For many of the participants in the focus group interviews, they perceived the inquiry project as an opportunity to get insight into a career in teaching. One participant, for example, mentioned that the inquiry project helped her "get a feel for" education issues and topics that she needed to be concerned about as a teacher. The participant further explained that the projects helped show her the type of commitment it takes to be a teacher and whether this was something she really wanted to pursue. She explained, "Teaching is a something that you need to want to do it because you love it, not because it is a job." The inquiry projects helped her to understand the depth of issues and commitment that embody the life of a teacher.

Another participant shared how the inquiry project, along with the PFS class, was instrumental in helping her figure out if she really wanted to continue in education. The

participant explained, "Coming in this class gives a pretty good idea if teaching is something you are passionate about or maybe you want to try something else. That's important." Indeed, that is important because of the multifaceted nature of the teaching vocation. It requires commitment and skill. Many participants shared how they became more aware of what it takes to be a teacher because of the inquiry projects. Yet, it was a challenge that many were eager to accept. For instance, one of the participants shared that, "Going through this class made me realize what's got to go into the process of becoming a teacher. That's what excited me. I was like okay; I can't wait to do this."

The anticipation for a future career in teaching seemed to be contagious among the participants who were part of the focus group interviews. Many participants found that their inquiry project further solidified the actual teaching field or area (grade level and content area) they intended to pursue. One participant shared how the inquiry project helped her to delve deeper into a possible role as a special education teacher. The participant explained, "I learned from someone's inquiry project about special education and inclusion. The project really helped me understand there are a lot of different people in the world." This participant shared how she had decided to double major in elementary and special education and how she was excited to have an inclusive classroom, where all students of any ability are welcomed.

The second quote was offered by a participant who planned to focus on early childhood development. This participant shared how the inquiry project was beneficial to her future because of how it challenged her to think about early childhood and child development. She added, "The inquiry project made me think of different aspects of early childhood education and how I could go into different areas. It made me more aware of child development ideas and topics that I did not previously know." To the participants who were quoted above, the inquiry was beneficial in that it provided greater clarity about kind of commitment it will take for their future careers as educators. Similarly, the participants gained more in-depth and refined knowledge related to specialized areas in education like early childhood and special education. Thus, the participants made strong connections between their inquiry projects and their future role as teachers.

Discussion

Peter Nelsen (2015) asserts that teacher education programs must create a professional context where a habitus of intelligence thrives. Curiosity and the willingness to engage in inquiry are important features for the development of "intelligent dispositions" (Nelsen, 2015, p. 88). Furthermore, knowledge building is an intelligence disposition. Knowledge building through inquiry can be infused into teacher education to help prepare teachers who are in the habit of questioning and thinking critically.

This article examines an inquiry project that was implemented with first year students who were all interested in a future career in teaching. We framed our study on Knowledge Building Theory. To review, this theory asserts that knowledge building happens vis-a-vis: 1) questions, which are authentic and challenging; 2) epistemic artifacts, which reflect an intentional process of inquiry; and 3) collective sharing, which reflects how knowledge is a communal activity. In this discussion section, we return to these three features of our theoretical framework and examine the findings from the lens of Knowledge Building Theory. We organize the section by discussing each feature in relationship to the study's findings. The discussion section will conclude with recommendations for a future research agenda related to knowledge-building in teacher education.

Questioning

Asking questions is a key component of constructivist practice and knowledge building. Questioning is the foundation of inquiry-based learning. However, we found that questioning was not included in what participants described as the inquiry process. As represented in Figure 2, the participants only identified four components of the inquiry process: 1) going to the library, 2) searching databases, 3) writing about the research, and 4) presenting the research. All four of these components were referenced specifically as positive features of the inquiry process. Yet, we found it interesting that none of the participants mentioned that the research process begins with a research question. Likewise, none of the participants discussed how research questions should be refined to narrow a topic or issue.

The role of questioning in the inquiry process was curiously missing from the participants' responses even though it was something that was emphasized in the PFS classes. Indeed, the PFS course instructors provided the participants with detailed directions about their

inquiry projects, which included an emphasis on how the inquiry research project was designed to help learners engage their curiosities and questions about education. Participants chose their inquiry project topics based on their questions about education. A lot of time was given in the PFS seminar sessions for participants to share and refine their questions. Yet, why did the participants not identify questioning as a component in the inquiry process? We have a couple of hypotheses. First, the omission of questioning and refining the question—as part of the inquiry process—may be due to the focus group interview questioning protocol. Participants discussed their inquiry projects in response to the focus group questions about the course's most meaningful part and the beneficial skills that they gained from the course. There were no questions that specifically mentioned the inquiry process for the purpose of not asking leading questions to the participants. However, if there were questions more specific to the inquiry process it is possible the participants would have discussed the role of questioning.

A second hypothesis is that participants may have just assumed that questioning is part of the inquiry process and were using questioning and inquiry in synonymous ways. Perhaps they were not differentiating between the two terms. A third hypothesis is that participants may have just forgotten about developing a research question so that part of the inquiry process seemed unimportant. The participants' omission of the research question from the inquiry process was a teachable moment for the entire research team. Scardamalia and Bereiter (2006) contend that starting with a question is the foundation for knowledge building. We concur. Learners should explicitly recognize that inquiry is grounded in researchable questions about problems or issues. Questioning is the starting point of what we call the Inquiry Processing Cycle (Byker, Coffey, Harden, Good, & Brown, 2016). The Inquiry Processing Cycle is illustrated in Figure 3.
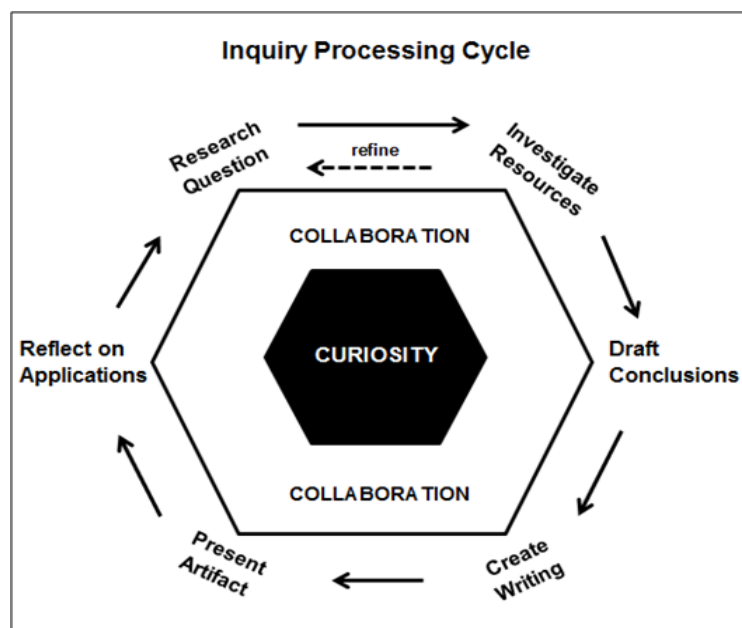
Figure 3. Depiction of the Inquiry Processing Cycle

As Figure 3 shows The Inquiry Processing Cycle depicts the process of inquiry as a continual cycle. The Inquiry Processing Cycle combines the findings of this study with the tenets of Knowledge Building Theory in a grounded theory way (Glaser & Strauss, 1967). Curiosity is at the very locus of the model as all inquiry is focused—or should be focused—on a learner's curiosity about an issue or problem. Asking smart questions about the issue leads to a researchable questions. However, not all questions are created equal. In order to be researchable, a learner needs to refine the question and narrow in on an actual topic. For example, in this study one of the participants started with the following as a research question, "What makes for a successful student in the classroom?" There is a researchable question there, but it needs to be refined. After a discussion with the participant, she shared that what she really wanted to know is this: What are ways that the teacher can arrange the physical space in the classroom to allow her students to be successful? The participant refined her question even more by narrowing in on elementary school teachers. The process of question refinement happened through a discussion of her question and an initial investigation of resources about the topic. Refining the research question is an investment in time, but it is an essential part of the construction of knowledge through inquiry-based learning.

Questions also need to be authentic to the learner's curiosity and as Scardamalia and Bereiter (2006) would say "elicit real ideas" (p.117). We would be remiss if we did not add to

the list of hypotheses the possibility that the study's participants found their questions inauthentic. Even though the participants were able to choose their topics, they were confined to issues in education. The rationale for doing that was to introduce the participants to educational challenges they would encounter as future teachers. Yet, the research team has debated—and continues to discuss—whether future inquiry-projects should be solely focused on educational issues or whether the projects should stem more from the PFS students' questions about being first-year students. For example, some participants at the beginning of the PFS course wanted to find out about all the resources in the library that they could use as students. Would this question make for a more authentic inquiry project? This is an issue that requires future research and should be part of a larger discourse among teacher educators.

Epistemic Artifacts

Participants also identified that the inquiry process included the creation and presentation of their research artifacts. Yet, the participants did not recognize the role of reflection in developing their artifacts into something epistemic. Reflection was missing from what the participants identified at the inquiry process (see Figure 2). However, we contend that reflection is a necessary component of constructing epistemic artifacts that poses additional questions for the advancement of further knowledge. In our Inquiry Processing Cycle, we include "Reflecting on Applications" as the concluding component of the inquiry processing cycle. Yet, reflection is not the final component. Rather, reflection informs future research questions. Reflection keeps the Inquiry Processing Cycle vibrant and in flux. Barbara Junisbai (2014) suggests there is an evolutionary nature of the learning process, which can be frustrating to students. Reflection, though, helps students mediate that frustration towards the pursuit of further inquiry about their questions. Yet, reflection needs to be an intentional part of the Inquiry Processing Cycle.

To further the construction of epistemic artifacts, there are a number of reflection questions that students should probe. Many of these questions would build on the students' findings from their inquiry project. For example, strong reflection questions would include:

- What more do you want to know about this topic?
- What further questions do you have about your issue or topic?
- What are the ways that you will explore these further questions?
- How is this topic connected to your future teaching practice?

● What difference will the issue or topic make in your development as a teacher?

All of these reflection type questions can push students in their inquiry as well as foster a habitus of knowledge building where the inquiry process does not just stop after the project is presented. Indeed, reflection questions provide the momentum to keep the Inquiry Processing Cycle churning toward new inquiries.

Collective Space

Reflection also needs to be shared in community. The whole Inquiry Processing Cycle is supported through collaboration. Scardamalia and Bereiter (2006) contend that knowledge building has a collective quality. Epistemic artifacts are developed when shared in community. In this research study, we were pleased that the participants identified collaboration as an important element in the writing and presentation of their inquiry projects. Many of the participants shared that the collaboration was both a new and enriching experience. Their sentiments echo how one participant explained that sharing the writing helped her foster ideas and helped to improve her writing. For this participant, the communal act of sharing her writing and inquiry project was an experience she could "grow from."

The community oriented aspect of inquiry supports the core of the Inquiry Processing Cycle. Our model (see Figure 3) shows how collaboration surrounds the core of inquiry, which is curiosity. The idea here is that collaboration strengthens and girds curiosity. Indeed, inquiry is furthered enhanced through collective spaces. Participants in this study explained how they developed their inquiry projects when they were given the space to share and draft those projects. Such spaces need to be safe in that students can share freely about where they are in the process. Teacher educators would be wise to build in collective spaces early and often in the course calendar. To develop their inquiry project, students need time to collaborate and share their progress during each component of the Inquiry Processing Cycle. Brainstorming and refining research questions are ways to collaborate at the Research Question stage of the Inquiry Processing Cycle, whereas peer writing conferences would be appropriate collaboration at the Draft Conclusions stage. A benefit of regular collaboration is that it helps form a strong learning community. Another benefit is the development of knowledge building habits where inquiry is valued as an experiential learning process (Byker, 2015).

Future Research

The Inquiry Processing Cycle and Collaboration. A future research agenda would go deeper into examining the relationship between the Inquiry Processing Cycle and the development of collective spaces for collaboration. The scope of our study was focused on first-year undergraduate student participants. Future research could include an examination of teacher candidates who are already accepted to the College of Education. Additionally, future research would consider the seemingly dynamic role of course instructors as facilitators in the Inquiry Processing Cycle. Such research could start by investigating what Cook and Buck (2014) describe as a paired inquiry, where undergraduates students conduct their inquiry projects with campus experts.

The Inquiry Processing Cycle and Topic Selection. Future research would also examine the participants' topic and project choices. One interesting finding that emerged from this study was how many participants chose the parental involvement category for their inquiry project. Indeed, parental involvement was the most popular inquiry topic category among the participants. It could be that first-year students are interested in the parent-teacher relationship because they are wrestling with the transition to independent adulthood while at the same time redefining their relationships with parents or guardians. Or the popularity of the parental involvement topic may be that as future teachers, the participants have concerns about whether a child's parent will take them seriously. More research is needed into why prospective teacher candidates choose the inquiry projects that they do. Another area of future research is to examine the relationship between creativity and the choices for inquiry project formats. Many of the participants in this study elected to write a traditional research paper for their inquiry project. The research paper format is straightforward and structured. Yet, it does have constraints. A research paper often confines creativity and the integration of digital technology. More research is needed into the affordances and constraints of other possible formats to present inquiry projects. Additionally, more research is needed about ways to enhance the creativity of an inquiry project while still ensuring that it is rigorous.

The Inquiry Processing Cycle and Other Research Areas. Data collection was limited regarding classroom activities designed to facilitate research question development, which is the

critical first step in the cycle. Further study is needed to investigate the impact of activities designed to guide students in the formulation of quality research questions on the Inquiry Processing Cycle. Additionally, more research is needed on the inclusion of theories and theoretical frameworks in the inquiry process to guide students in their research questions. For example, the inclusion of critical theories, like the Critical Cosmopolitan Theory (Byker, 2013, 2016), may help students throughout the Inquiry Processing Cycle. Data collected indicated a need to better understand the impact of the course in generating meaningful reflections on applications, the final stage of the Inquiry Processing Cycle. Additional research is needed to understand strategies for abstracting reflections on applications toward broader rationales for inquiry. Future research could also include the tracking of students regarding measures of student success like retention, academic performance, and on-time graduation. Longitudinal studies of the impact of the Inquiry Processing Cycle on teaching practice would be another avenue of future research.

Conclusion

Inquiry feeds curiosity. Our study examined the impact of an inquiry-based learning program among a cohort of first-year undergraduates, who are all aspiring to enter the field of education someday. We found that inquiry-based learning had positive effects on participants' understanding of: the complexity of educational issues; the process of inquiry; and their future career in teaching. The participants, though, had a very limited understanding of the overall inquiry process. Through the lens of the Knowledge Building Theory, we developed the Inquiry Processing Cycle, which is a conceptual model for the inquiry process. The Inquiry Processing Cycle centers on the linkages between curiosity and inquiry. The cycle includes developing and refining research questions, investigating resources, drafting conclusions, writing, presenting, and reflecting. We found that collaboration strengthens all these parts of Inquiry Processing Cycle. The Inquiry Processing Cycles is an instructive tool that captures the constructivist process of inquiry-based learning. In conclusion, we trust that the Inquiry Processing Cycle will benefit educators—especially in teacher education—in their instruction and facilitation of the inquiry process in teaching and learning. It is a cycle that can help prospective teachers develop into effective teachers who can guide children in their curiosities.

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Appendix

Focus Interview Questions:

1. As you think back over the semester, what aspects of this course have been the most meaningful?
2. What were the specific contributions your instructor or instructors added to your learning in this course?
3. As you participated in all aspects of this course, what surprised you?
4. Did anything surprise you about schools?
5. From this course experience, what new understandings have you gained?
6. What did you gain from what it takes to be successful at UNC Charlotte?
7. Tell me about the skills you learned, if any, that benefited you in other courses.
8. What other skills did you learn that helped you in other courses?
9. How would you describe your advising experience?
10. What were the benefits and limitations of this course/experience?
11. In what ways do you think this course prepares you for your degree/career?